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[54] **METHOD AND APPARATUS FOR NAVIGATION WITHIN THREE-DIMENSIONAL INFORMATION LANDSCAPE**

[75] Inventors: **Steven L. Strasnick**, Mountain View; **Joel D. Tesler**, Cupertino, both of Calif.

[73] Assignee: **Silicon Graphics Inc.**, Mountain View, Calif.

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[58] **Field of Search** 395/119, 127, 395/140, 128, 155, 161, 139, 160

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,816,726	6/1974	Sutherland et al.	382/41
4,868,771	9/1989	Quick et al.	395/127 X
4,928,247	5/1990	Doyle et al.	395/160
4,994,989	2/1991	Usami et al.	395/128 X
5,043,920	8/1991	Malm et al.	395/140 X
5,072,395	12/1991	Bliss et al.	364/443
5,150,457	9/1992	Behm et al.	395/140 X
5,164,904	11/1992	Sumner	364/436
5,295,243	3/1994	Robertson et al.	395/160
5,307,456	4/1994	MacKay	395/154

OTHER PUBLICATIONS

Fuller, "Using Autocad", Third Edition, Release 10 with 3-D, Delmar Publishers Inc., 1989, Chapter 17 and pp. 19-15, 19-16.

Flanagan, "Cyberspace meets Wall Street", Forbes, Jun. 22, 1992, pp. 164-168.

Advertisement for PV-Wave Point & Click from Precision Visuals Inc. 1991.

Guindon, "Cognitive Science and its Applications for Human-Computer Interaction", 1988, Lawrence Erlbaum Associates, publishers, chapter 5, pp. 201-233.

Grinstein, G., et al., "Visualization for Knowledge Discovery," *Intl. J. Intelligent Systems* 7: 637-648 (1992).

Carlbom, I., et al., "A Hierarchical Data Structure for Representing the Spatial Decomposition of 3-D Objects," *IEEE CG&A*:24-31 (Apr. 1985).

Carlbom, I., et al., "Planar Geometric Projections and Viewing Transformations," *Computing Surveys* 10 (4.1):465-502 (Dec. 1978).

Alexander, M., "GIS Sprouting Corporate Wings," *Computerworld*, p. 20 (Jul. 22, 1991).

Alexander, M., "Visualizing Cleared-Off Desktops," *Computerworld* 25 (18), p. 20 (May 6, 1991).

(List continued on next page.)

Primary Examiner—Mark K. Zimmerman

Attorney, Agent, or Firm—Sterne, Kessler, Goldstein & Fox P.L.L.C.

[57] **ABSTRACT**

A method and apparatus for navigating within a three dimensional graphic display space and manipulating information and data represented by objects in display space. The method and apparatus presents users with a vastly expanded view of their data, displayed with a richer dimensionality. Data objects represented by graphic objects are arranged into a navigable landscape representing the containership and contextual relations of the underlying data. The graphic objects are columns, pedestals and disks, which represent data blocks, cells, and comparative values respectively. The columns rest on the pedestals. The disks are located with respect to the top of the column to signify a comparative attribute. The pedestal rest upon a ground plane. The ground plane represents a threshold value. Data attributes may be represented by visual, textual, executable, or audible characteristics of the display. The user may interact with the data to affect change in the underlying data or its representation within the display space. Less detail is displayed as the user navigates away from objects within the display space. Objects change from three-dimensional to two-dimensional, to line segments as the user moves away from the objects. Visible attributes such as text and icons are not displayed for distant objects.

48 Claims, 30 Drawing Sheets